

# THE ELECTRICAL SIGNS OF LIFE AND THEIR ABOLITION BY CHLOROFORM.<sup>1</sup>

AS it was not possible to show the actual experiments, Dr. Waller illustrated his lecture by diagrams, and introduced his method of presenting

was deduced that isolated nerve, by reason of its showing no fatigue, but giving perfectly regular responses, is a favourable symbol of living matter on which to study the effect of drugs and reagents. From these experiments was proved the fact that chloroform is eight times more powerful than ether, and that 2 per cent. vapour of chloroform is the safe dose. Dr. Waller attributed deaths from overdose of chloroform to inattention to the great scientific principle of measurement.

Records were shown of the electrical effects produced by a series of illuminations of the eyeball, and of similar effects produced by pressure on the eyeball and by electrical excitation; Dr. Waller at first thought these latter effects were the same as those produced by light on the retina, and called them "blaze currents," but afterwards found they were characteristic of all living tissues. The petal of a flower and living seeds give blaze currents.

Dr. Waller described his records of the electrical effects of light on a green leaf; sunlight and the arc light were used; it seemed natural that the vegetable retina should be sensitive to light; the response is a double one, first

negative then positive, dissimilation then assimilation; the carbonic acid function of the green leaf is probably attended by electrical effects; positive or assimilation

them on the screen by placing in the lantern smoked plates on which he sketched in view of the audience diagrams of the apparatus (battery, induction coil, electrodes, galvanometer) employed in the experiments, and showed the methods by which the photographic records were obtained.

The physiologist is engaged in the task of learning how plants and animals absorb, transform, distribute, and disperse the energy stored in food and manifested in each act of life—in a word, of studying the signs of life; and in the electrical change which accompanies all chemical change we have the most delicate means of addressing two questions to living matter: Are you alive? How much are you alive?

Tissues survive the death of the animal or plant. Six objects were chosen as representative examples of living matter—muscle, nerve, retina of the eyeball, a green leaf, a flower petal, and a seed. The characteristic of life is perpetual change, metabolism—building up and breaking down—anabolism, and katabolism. From the records shown of the electrical responses to excitation of muscle and nerve, it

<sup>1</sup> Abstract of lecture delivered by Dr. Augustus D. Waller, F.R.S., to the members of the British Association at York.

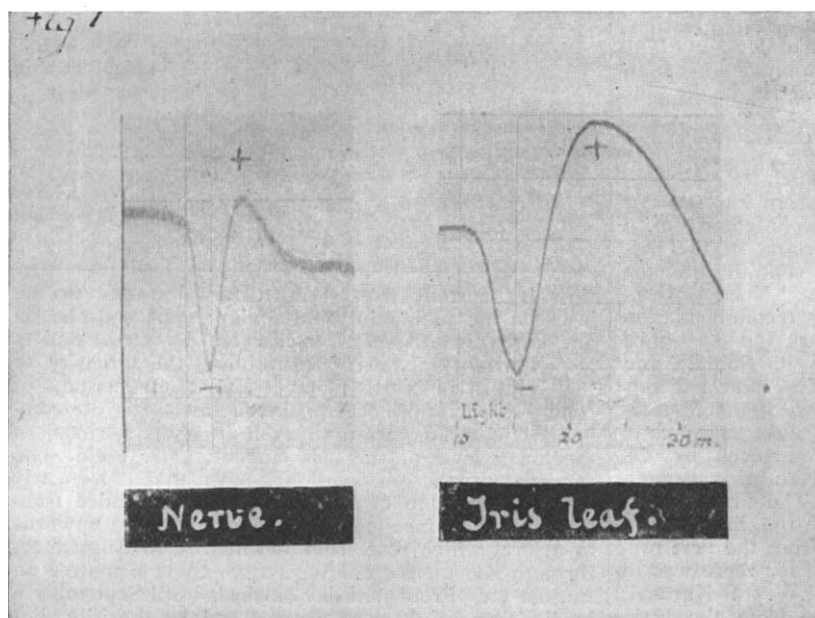


FIG. 1.—Negative variation of nerve compared with electrical effect of light on Iris leaf.

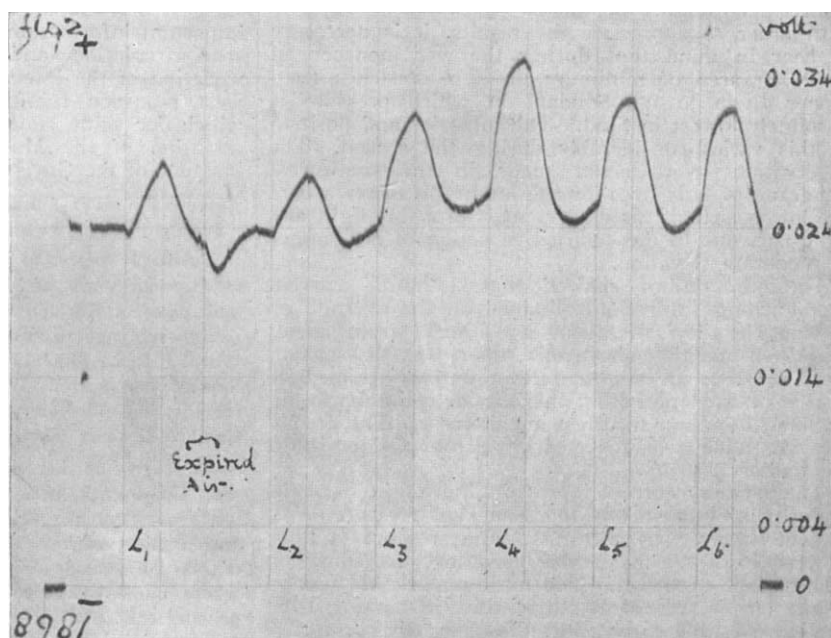


FIG. 2.—Increase of the electrical effects of light on leaf of *Nicotiana* caused by 4 per cent.  $\text{CO}_2$ .

active effect is far more pronounced in vegetable than in animal protoplasm (see Fig. 1). A leaf of *Nicotiana* was illuminated for five minutes at intervals of ten minutes, and gave a deviation of the magnet of

the galvanometer amounting to  $-2/100$  volt, followed by a deviation of  $+2/100$  volt; it was then subjected to an excess of  $\text{CO}_2$ , which caused temporary intoxication, from which it afterwards recovered. Small quantities of  $\text{CO}_2$ , such as 4 per cent., exhibited to the leaf cause increased electrical effects, which are a galvanometric expression of increased chlorophyll action (see Fig. 2); that is, the more assimilation, the more the electrical sign of assimilation. The photographic records indicate dissimilative effects in the minus direction and assimilative action in the plus direction.

#### METEOROLOGICAL KITES IN INDIA.

THE India Meteorological Department has recently given in a number of its Meteorological Memoirs (vol. xx., part i.) "an account of the preparations made for determining the conditions of the upper air in India by means of kites." The Government of India, acting on a strong recommendation by the Royal Society, about three years ago sanctioned the inclusion of the exploration of the middle and higher atmosphere by means of kites and balloons as a part of the scheme of operations of the Meteorological Department. Two officers were deputed to Germany to study the methods employed by the Aeronautische Observatorium des Königlich Preussischen Meteorologischen Instituts. The first part of the memoir gives a description of the instruments employed, and the results obtained from the first preliminary ascents. The place selected for these was in Lower Sind, about six miles W.N.W. of Karachi, a mile from the sea and ten miles from the Hala Range on the west, forming the boundary between Lower Sind and Baluchistan.

The ascents were made in the last week of August and first fortnight of September, 1905, shortly before the withdrawal of the south-west monsoon current from Upper India.

In order to appreciate the results, it is necessary to bear in mind that during the wet monsoon in India an area of minimum pressure stretches from Upper India to the Soudan, in which pressure is absolutely lowest in Sind. The intensity and position of this varies considerably during the season. The observations were hence made in the south-west quadrant of this area of minimum pressure, where the lower cyclonic air movement is probably light and irregular, due to the obstructive action of hill ranges of moderate elevation.

The observations showed that a humid current (approaching saturation) obtained on the average up to an elevation of about 2500 feet (from about W.S.W.), and that above this was a very dry current from west with slight northing, the intermediate region of transition from the humid to the dry being probably less than 1000 feet in thickness. The accompanying table gives selected data from the two most satisfactory ascents.

The very dry current represents indraught from the Baluchistan plateau to the Sind low-pressure area, which, however, as a result of the presence of hills, entered it at a considerable elevation, exceeding on the average 2500 feet. The most remarkable feature is the large increase of temperature in passing from the lower humid current into the upper dry current, of  $4^\circ \text{C.}$  to  $7^\circ \text{C.}$  in amount, and of the comparatively slow rate of decrease for some distance above that plane of transition. Almost equally remarkable is the sudden and comparatively abrupt change of the relative humidity from saturation to values of 5 and 6 only. Mr. Blanford many years ago established that in drought years in North-Western India

Date of ascent	Elevation, metres	Temperature, $^\circ \text{C.}$	Humidity:		Wind direction
			Rel.	Absolute. Grams per cub. m.	
Aug. 28	Surface	28.6	70	19.5	S. 70 N.
—	795	21.1	100	18.2	"
—	1000	25.9	24	5.8	West with slight northing
—	1285	28.7	5	1.4	"
—	1380	27.3	6	1.6	"
Sept. 12	Surface	28.1	85	23.0	S. 60 W.
—	635	21.9	100	19.1	"
—	900	25.6	42	9.9	West with slight northing
—	1015	25.4	19	4.4	"

this dry current from Baluchistan descends to the level of the plains in Sind and extends southwards and eastwards to very considerable distances, and is an important factor in determining the intensity of the drought in North-Western India, and perhaps of conditioning it. Another point of interest is the comparatively rapid variation, even in short periods, of the lower level of this dry current. Mr. Field, who carried out the observations, says that "a nearly saturated stratum of air from the sea extended from the ground surface (10 metres above the sea) upwards to a level which rose from 500 metres on August 27, through 800 metres on August 28, to 1130 metres on August 31. From that day onwards until September 9 its limiting height was not reached by the kite, but probably exceeded 1000 metres. Its upper limit fell again to 600 metres on September 12."

The observations give valuable and interesting information of what may perhaps be termed an outlying portion of the south-west monsoon current. They suggest that the extension of the work will give most important information respecting the south-west monsoon circulation, and perhaps on the causes of the variation of the intensity and extension of the south-west monsoon rainfall, one of the great problems which for some time past has engaged the earnest attention of the Meteorological Department at the instance of the Government of India.

#### NOTES.

We deeply regret to announce the death, at the age of seventy-four years, of Mr. C. Baron Clarke, F.R.S., which took place at Kew on Saturday last, and, at the comparatively early age of fifty-two years, of Prof. H. Marshall Ward, F.R.S., which occurred at Babbacombe, Torquay, on Sunday last. Prof. Ward, who had been ill for some months, had filled the chair of botany at the University of Cambridge since 1895.

On August 20 there passed away at his beautiful country seat, Coles Park, near Buntingford, Herts, in his eightieth year, one who is well known to mineralogists as joint author with the late Mr. W. G. Lettsom of the "Manual of the Mineralogy of Great Britain and Ireland," and whose name will ever be linked with perhaps the finest private collection of minerals which was ever brought together in this country. Mr. Robert Phillips Greg as a young man took great interest in the fine collection which his father, a noted economist and antiquary, had purchased from the executors of its previous owner, Mr. Thomas Allan, F.R.S., and spent considerable sums of money in acquiring new specimens and bringing the collection up to date. After the publication of his "Manual" in 1858 he